الصفحة	الامتحان الوطني الموحد للبكالوريا المسالك الدولية – خيار أنجليزية **الدورة العادية 2019** **- الموضوع -**	المملكة المغربية وزارة التربية الوطنية والتكوين المهني والتعليم العالي والبحث العلمي المركز الوطني للتقويم والامتحانات والتوجيه
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♦♦♦

المادة	علوم الحياة والأرض	مدة الانجاز	3
الشعبة أو المسلك	شعبة العلوم التجريبية : مسلك علوم الحياة والأرض – خيار أنجليزية	المعامل	7

Candidates may use non-programmable calculators

Section I : Knowledge Retrieval (5 pts)

I. Define the following notions:

1. Reverse fault; **(0.5 pt)**

2. Collision mountain range. **(0.5 pt)**

II. For each of the following propositions numbered from 1 to 4, there is only one correct suggestion in each set. **Copy down** these pairs (1; ..), (2; ..), (3; ..), (4; ..), and **match** each number with its corresponding letter. **(2 pts)**

1. In comparison to the continental crust, the oceanic crust is : a. thicker and denser ; b. thicker and less dense ; c. thinner and denser ; d. thinner and less dense.	**2. Subduction zones are characterized by andesitic volcanism linked to partial fusion of :** a. hydrated peridotite of the subducted plate ; b. unhydrated peridotite of the subducted plate ; c. hydrated peridotite of the overlapping plate ; d. unhydrated peridotite of the overlapping plate.
3. Ophiolite is a rock complex that has the following constituents : a. peridotite, andesite, dolerite sheeted dycke and basalt; b. andesite, gabbro, dolerite sheeted dycke and basalt; c. peridotie, gabbro, andesite and basalt; d.peridotite, gabbro, dolerite sheeted dycke and basalt.	**4. In subduction zones, there are thermal anomalies :** a. positive in Benioff zone and negative in volcanic arc ; b. positive in Benioff zone and in volcanic arc ; c. negative in Benioff zone and in volcanic arc ; d. negative in Benioff zone and positive in volcanic arc .

III. Copy down on your exam sheet the number corresponding to each proposition and **write** whether the statements are **"true"** or "**false"**. **(1 pt)**

a	The oceanic crust is made of granitic and gabbroic rocks.
b	In subduction zones, the earthquake focuses are distributed according to an oblique plane under the overlapping plate.
c	The mountain range obduction is the result of the burial of an oceanic plate under a continental plate.
d	Tip line folds resulting from a fault followed by a fold.

IV. Match the name of each rock (Group 1) with its corresponding characteristic (Group 2). **Copy down** these pairs (1; ..), (2; ..), (3; ..), (4; ..), and **match** each number to its corresponding letter. **(1 pt)**.

Group 1 : rocks
1. Andesite
2. Ophiolite
3. Gabbro
4. Peridotite

Group 2 : caracteristics	
a.	Magmatic rock with grain structure belonging to oceanic crust.
b.	Rock complex belonging to oceanic lithosphere.
c.	Magmatic rock with a microlite structure characterizing subduction zones.
d.	Magmatic rock with a grain structure belonging to an upper mantle.
e.	Magmatic rock with a grain structure characterizing collision zones.

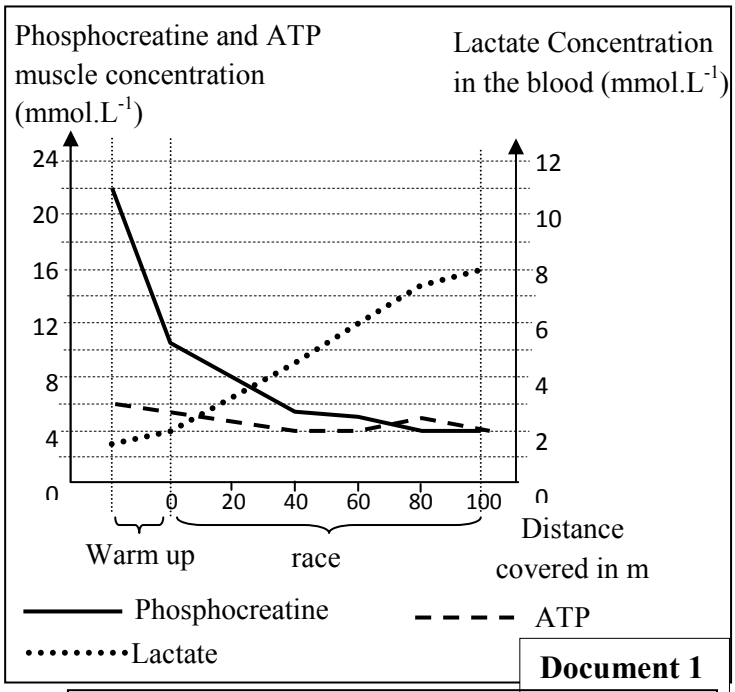
Section II: Scientific reasoning and communication in graphic and written modes (15 pts)

Exercise 1 (3, 25 pts)

During a short and intense exercise, such as in sprinting, the muscle power developed is very important. Therefore, ATP regeneration depends on a number of metabolic reactions. In order to understand the relationship between these reactions and how the body provides a sprinter with energy, we suggest the following data:

- During a warm up and a 10-second race, we have measured the variation of ATP concentration, phosphocreatine at the muscle level and blood lactate concentration in the sprinter. The results are presented in document**1**.

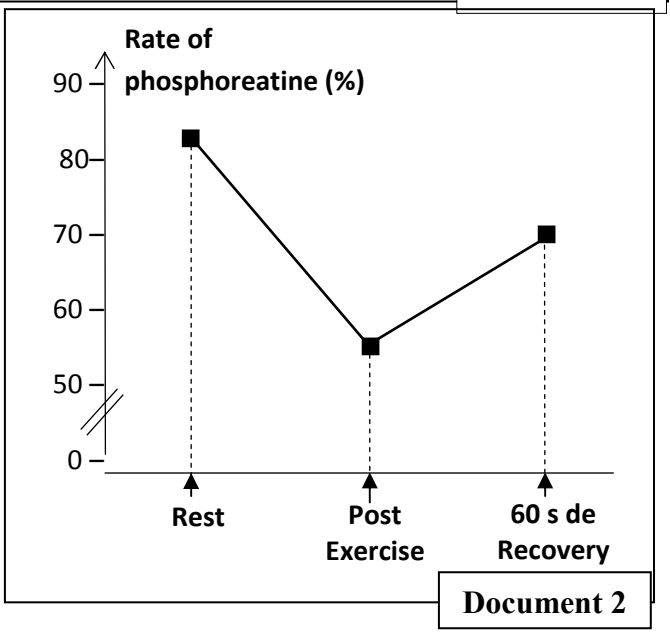
1. Describe the concentration variation of ATP, lactate and phosphocreatine in the sprinter (document **1**), then **give** an explanation of the ATP origin during this physical exercise. **(1pt)**



Document 1

- We have measured the evolution of phosphocreatine levels in a sportsman's muscular biopsies collected while resting, after 45-second exercise leading to exhaustion (post exercise), and after 60-second recovery. Document **2** presents the obtained results.

2. Bearing in mind that recovery is achieved thanks to the contribution of Oxygen carried by blood**, suggest a hypothesis** to explain phosphocreatine evolution after the 60-second recovery. **(0.25 pts)**



Document 2

- Document **3** presents the follow-up results of the concentration of the three phosphate compounds in a sportsman (PCr, ATP and inorganic phosphate « Pi ») before physical exercise, during a short-term physical exercise and after recovery. Document **4** explains the relation between ATP and phosphocreatine.

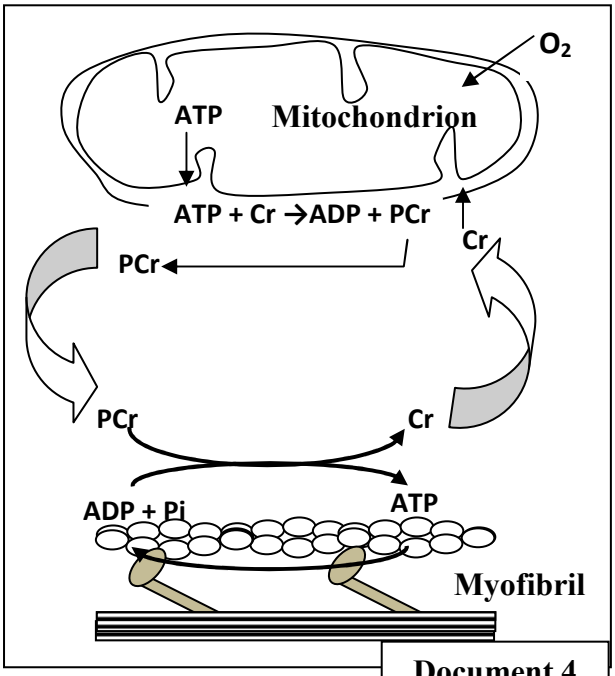
	before exercise	during exercise	after recovery
Pi	+	+++	+
ATP	++	++	++
PC	+++	++	+++

+ **:** low concentration ; ++ : average concentration ; +++ : high concentration

Document 3

3. What pieces of information can extracted from document **3. (0.75 pts)**

4. Based on your answer to question **3** and by exploiting the data in document **4, show** the relationship between the variations of the three compounds in the sprinter during exercise and after recovery, and then **verify** the formulated hypothesis (answer to question 2). **(1,25pt)**

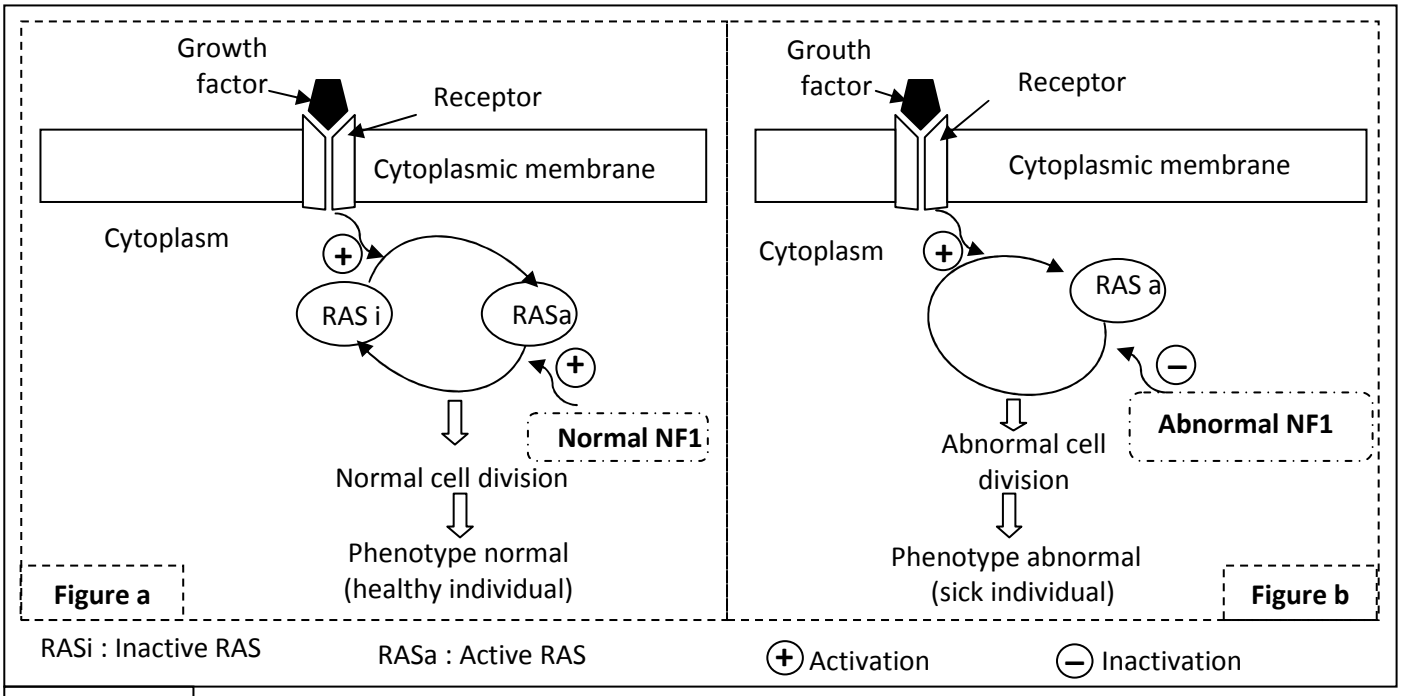


Document 4

Exercise 2 (4,75 pts)

Neurofibromatosis type 1 is a hereditary disease. Some symptoms of this disease include:
Pigmented spots on the skin (café-au-lait spots) with overall risk of benign tumor, neurofibroma, and poor skeletal formation.
To determine the genetic origin of this disease, we suggest the following data:

❖ Neurofibromatosis type 1 is associated with a protein called Neurofibromin 1 (NF1). This protein controls the activity of another protein called **RAS,** which interferes in cell division and multiplication. Protein NF1 is found in two forms, one normal and the other abnormal. The two figures **a** and **b** in document **1** represent the relation between protein NF1, RAS protein activity and the nature of cell division in a healthy person (figure a) and in a sick person (figure b).



Document 1

1. Use document **1** to **compare** the effect of NF1 protein on RAS protein in the healthy person and in the sick person, then **show** the protein-trait relationship. **(1 pt)**

❖ Protein NF1 synthesis is controlled by a gene called (NF1) which exists in two allelic forms. Document **2** presents a transcribed strand fragment of a normal allele in a healthy person and a transcribed strand fragment of an abnormal allele in a sick person. Document **3** presents an extract of the genetic code table.

Number of triplet	6531	6532	6533	6534	6535	6536
Fragment of a normal allele	AAA	ACG	AAA	CTG	TAG	GAA
Fragment of an abnormal allele	AAA	ACG	AAC	TGT	AGG	AAC

Reading direction →

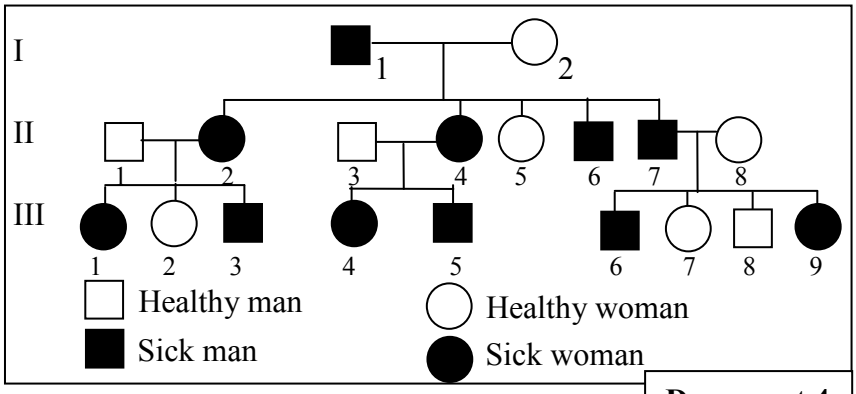
Document 2

Codons	UAA UAG	UCU UCC	ACA ACG	AUU AUC	GAU GAC	CUU UUG	UGU UGC	UUU UUC
Amino acids	Stop	Ser	Thr	Ile	ac.Asp	Leu	Cys	Phe

Document 3

2. Based on documents **2** and **3**, **give** mRNA and the amino acids sequences corresponding to the normal allele and the abnormal allele, then **show** the genetic origin of neurofibromatosis type 1. **(1.5 pts)**

- Document **4** presents a pedigree of a family whose members are affected by the neurofibromatosis type 1.



Document 4

3. Based on document **4** and knowing that I_2 is homozygote:

a. **Show** that the allele responsible for the disease is dominant and autosomal (non-sexual chromosome). **(0. 5pts)**

b .**Use** Punnett Square to **determine** the probability that couple II_1 and II_2 would give birth to a healthy child **(0.75pts)**

(Use the symbols M and m for the two alleles of the gene referred to above)

- Neurofibromatosis type 1 is a widely spread disease. It affects one person out of 3500 individuals of a given population. Let's suppose that this population abides by the Hardy-Weinberg equilibrium:

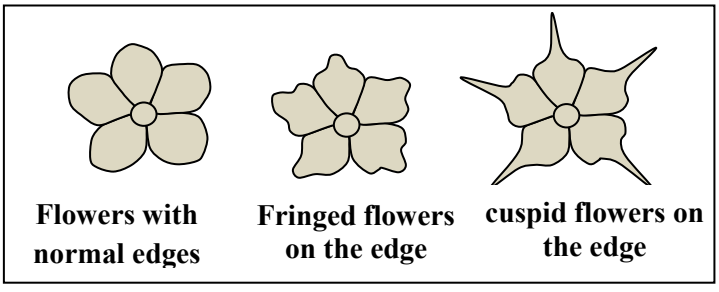
4. a. **Calculate** the frequency of the allele responsible for the disease and that of the normal allele. **(0.5 pt)**

b. Calculate the frequency of the heterozygote individuals. **(0.5pts)**

Exercise 3 (3.25 pts)

Phloxes are herbaceous plants whose flowers show a wide variety of colors and shapes, a fact which makes them so important in horticulture.

❖ To study the transmission of two hereditary traits; the colors and shapes of flowers in phloxes, we suggest the following data : Phloxes have a variety of colors, including white and cream colors, and the edges of their petals can be of different shapes as shown in the document on the right hand side.



The following table presents results of crosses realized in phloxes.

Crosses	Cross I	Cross II
Parents P_1X P_2	between plants with white flower color and plants with cream flower color	between plants with normal flower shapes and plants with cuspid flower shapes
Generation F_1	F_1 : plants with white flowers	F'_1 : plants with fringed flowers

1. What do you **deduce** from the results of the two crosses I and II? **(1 pt)**

Cross III - realized by the horticulturist between plants of pure lineage: plants with white flowers and regular shapes and plants with cream color flowers and cuspid shapes. This horticulturist wants to produce plants with cream color flowers and fringed shapes because the latter are easy to sell.

2. Bearing in mind that the two genes are independent,

a. Give the genotype of plants of generation F_1 (derived from Cross III), **(0,25 pts)**

b. Determine the theoretical results of generation F_2 derived from the cross between plants of generation F_1. **Justify** your answer using Punnett Square **(1,25 pts)**

3. **a. Give** the genotype of plants that the horticulturist wants to produce **(0.25 pts)**

b. Based on the obtained genotypes of generation F_2, **suggest** the cross that allows to obtain the greatest proportion of the desired phenotype. **Justify** your answer. **(0.5 pts)**

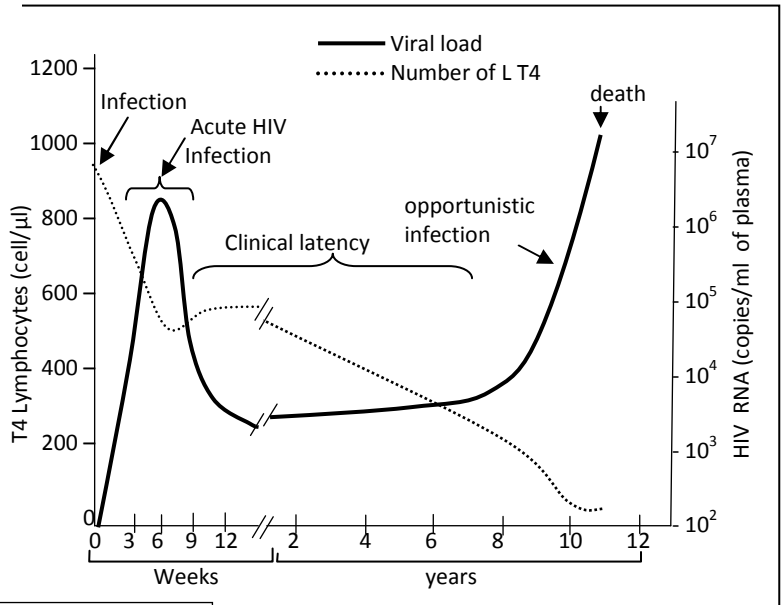
Use the following symbols: *-**B** and **b** for alleles responsible for the white color of flowers ;*
*-**C** and **c** for alleles responsible for the cuspid shape of flowers.*
*-**N** and **n** for alleles responsible for the normal shape of flowers.*

Exercise 4 (3.75 pts)

The infection by HIV (Human immunodeficiency virus) goes through many stages. The last stage is AIDS (acquired immunodeficiency syndrome) that is characterized by the appearance of opportunistic infections.

Knowledge of the immune system and the study of the infected individuals' reactions to HIV could help scientists to consider a vaccine against HIV. Document **1** shows the evolution of the number of lymphocytes T_4 and the virus load after infection by HIV.

NB. ***The viral load corresponds to the concentration of virus in blood and is reported as the number of viral RNA per millimeter of plasma.***



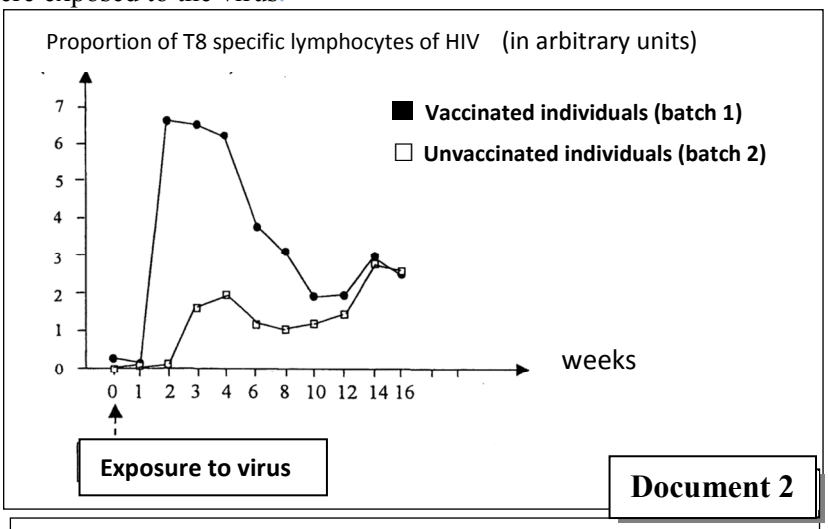
Document 1

1. Based on document 1, **describe** the evolution of the number of lymphocytes T_4 and the viral load, then **deduce** the effect of HIV infection on the immune system. **(1.25pts)**

❖ The scientific community nowadays agree that for the vaccine to be effective against HIV, it must stimulate specific immune responses. To develop a vaccine, researchers have realized the following study: To test the vaccine, two batches of uninfected monkeys by HIV are used:

- The monkeys in the first batch received a series of five injections of vaccine;
- The monkeys of the second batch did not receive any injection.
- Afterwards, the two batches of monkeys were exposed to the virus.

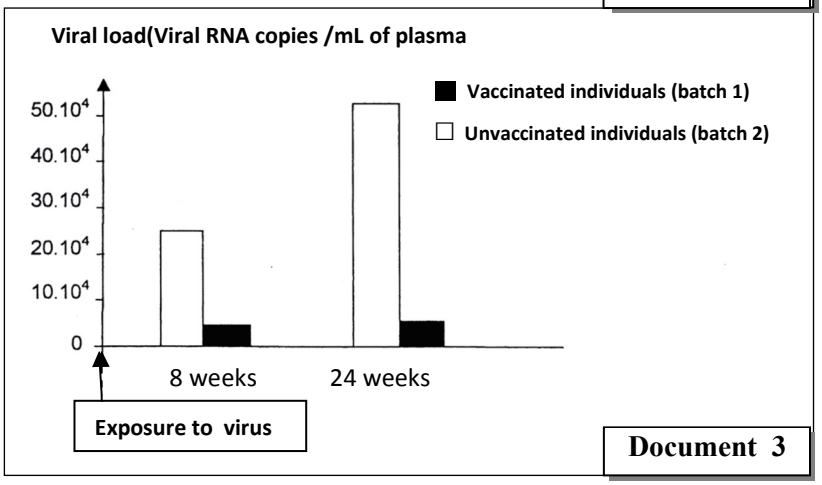
We evaluate the proportion of specific lymphocytes T_8 with regard to HIV in the monkeys' blood. Document **2** presents the results obtained.



Document 2

2. Compare the evolution of proportions of specific lymphocytes T_8 with regard to HIV between the vaccinated monkeys and the unvaccinated monkeys, then **deduce** the characteristic of the immune response explaining the observed difference. **(0.75 pts)**

-We measured the viral load in monkeys of the two batches after 8 and 24 weeks of exposure to the virus. Document **3** presents the results of the measurements.

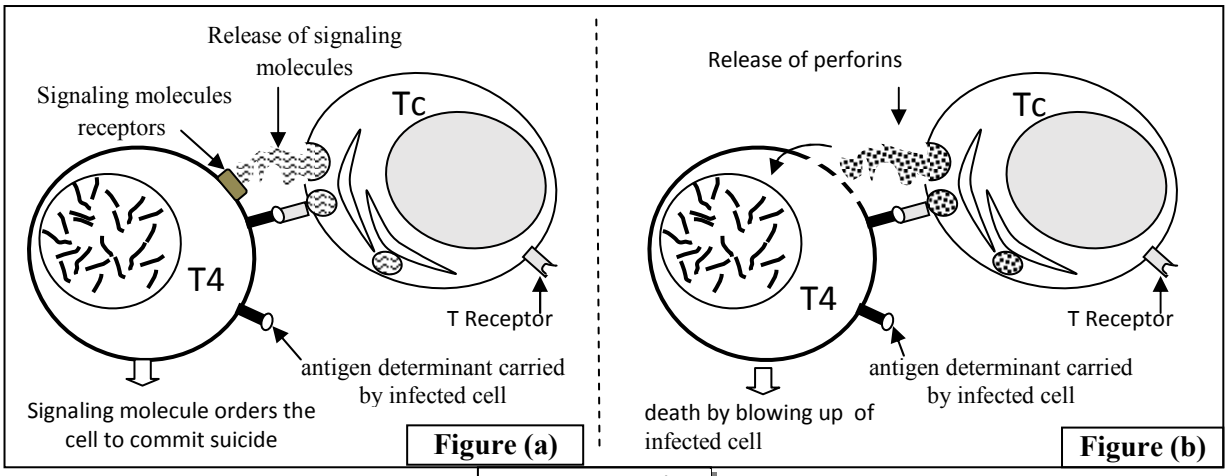


Document 3

3. Compare the viral load in vaccinated and unvaccinated monkeys, then **deduce** the action of the experimental vaccine on the viral load. **(0.75 pts)**

❖ The study of the destruction mechanism of lymphocytes T_4 infected with HIV, and destroyed by lymphocytes cytotoxic T, allows to identify two mechanisms leading to the death of the target cell. Document **4** presents these two mechanisms.

NB. Despite the destruction of lymphocytes T4 infected with HIV, the monkeys continued to produce other uninfected lymphocytes T_4.



Document 4

4. Based on document **4** and your answers to questions 2 and 3, **explain** the action mechanism of the tested vaccine on monkeys. **(1 pt)**

§------ END -------§

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الامتحان الوطني الموحد للبكالوريا
المسالك الدولية – خيار أنجليزية
الدورة العادية 2019
- عناصر الإجابة -

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المملكة المغربية
وزارة التربية الوطنية والتكوين المهني والتعليم العالي والبحث العلمي

المركز الوطني للتقويم والامتحانات والتوجيه

المادة	علوم الحياة والأرض	مدة الانجاز	3
الشعبة أو المسلك	شعبة العلوم التجريبية : مسلك علوم الحياة والأرض – خيار أنجليزية	المعامل	7

Questions	Key and Marking Scale	Note
	First part : knowledge Retrieval (5 pts)	
I	Definitions : 1. **Reserve fault** :brittle tectonic deformation characterized by a relative movement shortening the two separate compartments 2. **Collision mountain chain** : Mountain range resulting from the confrontation of two continental lithospheres following the closure of an oceanic area separating them	0.5 0.5
II	(1, c) ; (2, c) ; (3, d) ; (4,d)	0.5×4
III	(a- false) ; (b- true) ; (c- false) ; (d- false)	0.25×4
IV	(1, c) ; (2, b) ; (3, a) ; (4, d)	0.25×4
	Second part : scientific reasoning and communication in graphic and written modes (15 pts)	
	Exercise 1 (3,25 pts)	
1	**Description of the variation of the three compounds :** **ATP:** During the warm up, ATP concentration slightly decreases (from 6 mmol/L to 5 mmol/L). It reaches 4 mmol/L and remains constant during the race. **Phosphocreatine** : its concentration decreases during the warm up (from 22 mmol/L to 10 mmol/L). its reaches 4 mmol/L at the end of the race. **Lactate :** slightly increases during the warm up (from 1.5 to 2 mmol/L) then considerably increases during the race: it reaches 8 mmol/L at the end of the race. **The origin ATP during the race:** Hydrolysis of phosphocreatine followed by lactic fermentation at the level of myofibrils.	0.25 0.25 0.25 0.25
2	**Hypothesis :** Accept any hypothesis that relates phosphocreatine and cellular respiration.	0.25
3	**Information to be highlighted from Document 3 :** -Concentration of Pi is strong during the physical exercise and it is weak during the two other stages. -ATP concentration is stable in the three stages. -PCr concentration is average during physical exercise; it is strong during the two other stages.	0.25 0.25 0.25
4	**The relationship among three compounds :** **During exercise:** ATP hydrolysis changing to ADP and Pi with a release energy, which ensures muscle contraction. This explains the increase of Pi concentration. **The ATP stability** during the exercise is explained by its regeneration from phosphocreatine hydrolysis. **In the recovery stage**: with O_2, the respiratory oxidation allows ATP synthesis which **ensures regeneration** of phosphocreatine in mitochondrial membrane	0.25 0.25 0.25 0.25

	Verification of suggested hypothesis: Should take into account the relationship between cellular respiration and the regeneration of phosphocreatine.	0.25
	Exercise 2 (4,75 pts)	
1	**Comparison :** • In the healthy person, the normal NF1 activates the transformation from RASa to RASi, but in the sick person, the abnormal NF1 does not allow that transformation • In the healthy person, we have a normal cell multiplication but in the sick person, the cell multiplication is abnormal, thus the appearance of symptoms of the disease. **Relationship protein-trait:** Change in protein NF1 (NF1 abnormal) → uncontrollable cell division → the neurofibromatosis type 1 , thus existence of protein-trait relationship	0.25 0.25 0.5
2	- **In the healthy individual :** mRNA sequence : UUU UGC UUU GAC AUC CUU ..... Amino acids sequence : Phe - Cys - Phe - ac.Asp – Ile - leu …. - **In the sick individual :** mRNA sequence : UUU UGC UUG ACA UCC UUG..... Amino acids sequence : Phe - Cys - Leu - Thr – Ser – leu ……. - **Highlighting the relationship of gene- protein:** Mutation at the DNA level by deletion of nucleotide (A) of triplet 6533→ change in nucleotide sequence→ abnormal NF1 protein synthesis →no transformation from RASa to RASi → continued activation of RASa → uncontrollable cell multiplication→ symptoms of neurofibromatosis1.	0.25 0.25 0.25 0.25 0.5
3	**a- allele responsible for the disease is dominant** Justification: - the sick boy from a healthy homozygote mother I_2, which means that she is sick and heterozygote. - The disease is present in each generation and every sick child has one sick parent. The studied gene is not linked to sex because - Birth of a sick boy from a healthy mother and allele responsible for the disease is dominant - Birth of a healthy girl from a sick father and allele responsible for disease is dominant. **b- Probability to give birth to a healthy child from parents II_1 and II_2 is :** ♂**II_1 x II_2** ♀ **m//m x M//m** γ♀ / γ♂ | **M/ 1/2** | **m/ 1/2** **m/ 1** | **M//m 1/2** | **m//m 1/2** **the probability is ½**	0.25 0.25 0.25 0.25 0.25
4	**a- Calculate the frequency of alleles :** **We have :** f([M])= f(M//M)+ f(M//m)=p^2+2pq= 1/3500 **So :** f([m])= f(m//m)=q^2= 3499/3500…… As a result : f(m)= q = 0.99 et on a p+q=1 **So :** f(M)= p= 0.01……. **b- The frequency of having a heterozygote person is :** f(M//m)= 2pq= 2×0.99× 0.01= 0.01. …….	0.25 0.25 0.5

Exercise 3 (3,25 pts)

1

Deduction:

Cross I :

- F_1 is homogenous, the parents are pure lineage according to Mendel's first law …… — 0.25
- allele responsible for white color is dominant "B" and allele responsible for cream color is recessive "b" — 0.25

Cross II :

- F_1 is homogenous, the parents are pure lineage according to Mendel's first law …… — 0.25
- Intermediate trait appear (fringed flowers) indicate that we have codominance — 0.25

2

a-Plant genotypes of generation F_1 from cross III B//b N//C**:** — 0.25

b-Theoretical result of generation F_2 from the crossing between plants of generation F_1

Phenotype : [B, NC] [B, NC]
Genotype : B//b N//C
Gametes : B/ N/ ¼ ; B/,C/ ¼ B/ N/ ¼ ; B/ C/ ¼
b/ N/ ¼ ; b/, C/ ¼ b/ N/ ¼ ; b/ C/ ¼
Punnett Square : — 0.25

$\gamma♂$ / $\gamma♀$	B/,N/ ¼	B/,C/ ¼	b/, N/ ¼	b/, C/ ¼
B/,N/ ¼	**B//B N//N** [B,N] 1/16	**B//B N//C** [B,NC] 1/16	**B//b N//N** [B,N] 1/16	**B//b N//C** [B,NC] 1/16
B/,C/ ¼	**B//B C//N** [B,NC] 1/16	**B//B C//C** [B,C] 1/16	**B//b N//C** [B,NC] 1/16	**B//b C//C** [B,C] 1/16
b/, N/ ¼	**B//b N//N** [B,N] 1/16	**B//b N//C** [B,NC] 1/16	**b//b N//N** [b,N] 1/16	**b//b N//C** [b,NC] 1/16
b/, C/ ¼	**B//b N//C** [B,NC] 1/16	**B//b C//C** [B,C] 1/16	**b//b N//C** [b,NC] 1/16	**b//b C//C** [b,C] 1/16

— 0.75

The theoretical result obtained:
[B, NC] 6/16 ؛ [B, N] 3/16؛ [B, C] 3/16 ؛ [b,NC] 2/16 ؛ [b, C] 1/16 ؛ [b,N] 1/16 — 0.25

3

a. Genotype of the plant desired by horticulturist: (b//b, N//C)…… — 0.25
the cross that allows to obtain the greatest proportion of the desired phenotypes [b,NC]

Justification: Giving an interpretation — 0.25

[b, C] × [b,N]
↓
100% [b,NC] — 0.25

Exercise 4 (3,75 pts)		
1	**Description of obtained results :** The number of lymphocytes T4 gradually decreases after infection by HIV. It goes from 900 cells/µl to 50 cells/µl after 10 years of infection… Viral load has rapidly increased after infection to reach (between 10^6 and 10^7 copies/ml of plasma) in the 6th week of infection**.** After that, it has decreased to stabilize at a value of **(**10^3 and 10^4 copies/ml of plasma). After 8 **years,** it has again increased to reach a value upper to10^7 copies/ml of plasma …… **Deduction** HIV infection → decrease LT4 → decrease of the immune defense system of individual organisms → organism exposed to opportunistic diseases (weakening the immune system)	0.5 0.5 0.25
2	In vaccinated monkeys, unlike in unvaccinated ones, the production of LT8 is faster (after one week of exposure to HIV instead of two weeks for unvaccinated monkeys) and more intense (acute at 7 instead of 2 weeks for the unvaccinated monkeys) **Deduction:** The characteristic is immunological memory ……..…	0.5 0.25
3	**Comparison of the proportions of viral load in monkeys:** In week 8 of virus exposure, the viral load in unvaccinated monkeys is 5 times higher than in vaccinated monkeys. After week 24, the viral load has increased just a little in vaccinated monkeys while in the unvaccinated monkeys it has doubled. **Deduction**: The vaccine inhibits the multiplication of HIV ……	0.25 0.25 0.25
4	**Explantation :** The use of the vaccine leads to the increase of LTc → destruction of the lymphocyte LT4 infected by HIV in two ways: release of perforin and granzyme or/and the signals provoking apoptosis of the infected cell → decrease of the number of infected lymphocytes LT4 →decrease of viral load → to avoid the appearance of opportunistic diseases.	0.25 0.5 0.25